CLAIMS

1. An implantable medical apparatus for detecting diastolic heart failure, DHF,

    comprising a DHF determining device for determining at least one blood

    pressure parameter for detecting a DHF state of the heart of a patient,

    characterized in that said DHF determining device comprises a pressure

    measuring means (2,26) for measuring the absolute value of left atrial

    pressure during the diastasis phase just before atrial contraction for a

    predetermined workload situation and a rest situation of the patient, and a

    comparison means (18) for comparing the difference, ΔP, between left atrial

    pressure measured in said workload and rest situations with a predetermined

    pressure difference reference value for DHF detection.

2. An implantable medical apparatus for detecting diastolic heart failure, DHF,

    comprising a DHF determining device for determining at least one blood

    pressure parameter for detecting a DHF state of the heart of a patient,

    characterized in that said DHF determining device comprises a pressure

    measuring means for measuring the absolute value of the pressure in the

    pulmonary vein when the pulmonary valve is closed for a predetermined

    workload situation and a rest situation, and a comparison means (18) for

    comparing the difference, ΔP, between said pulmonary vein pressure

    measured in said workload and rest situations with a predetermined pressure

    difference reference value for DHF detection.

3. The apparatus according to claims 1 or 2, **characterized in** that an activity

    sensor (22) is provided for determining the workload of the patient.

4. The apparatus according to claim 1, **characterized in** that pressure compensating means (6,24) are provided for correcting the measured absolute value of left atrial pressure with the mean pressure in right atrium or in vena cava close to the right atrium.

5. The apparatus according to any of the preceding claims, **characterized in** that said DHF determining device comprises an impedance measuring means for measuring the impedance between a left ventricular electrode (8) and a second electrode (10) intended to be positioned in such a place that most of variations in the measured impedance are due to varying left ventricular volume, and in that ΔP values and corresponding values of the difference, ΔV, in the end-diastolic ventricular volume obtained from said impedances measured for said predetermined workload situation and for the patient in rest are supplied to a quotient forming means (54) to form the quotient $\Delta P/\Delta V$, and in that said comparison means (56) is adapted to compare said quotient $\Delta P/\Delta V$ with a predetermined quotient reference value for DHF detection.

6. The apparatus according to any of the preceding claims, **characterized in** that a first averaging means is provided to form an average value of said absolute pressures measured during a plurality of cardiac cycles with said predetermined workload situation and an average value of said absolute pressures measured during a plurality of cardiac cycles with the patient in rest.

7. The apparatus according to claim 6, **characterized in** that a second

averaging means is provided to form an average value of said impedance measured during a plurality of cardiac cycles with said predetermined workload situation and an average value of said impedance measured during a plurality of cardiac cycles with the patient in rest.

8. The apparatus according to any of the preceding claims, **characterized in** that a wireless communication means is connected to said comparison means for automatically sending the results of the comparison of said difference between measured pressures with said pressure difference reference values to external receiver means.

9. The apparatus according to claim 8, **characterized in** that said wireless communication means is connected to said comparison means for automatically sending the results of the comparison of said difference between said quotient $\Delta P/\Delta V$ in workload and rest situations with said quotient reference value to said external receiver means.

10. The apparatus according to any of the claims 1 – 7, **characterized in** that a storing means is provided for storing the results of the comparison of said difference between measured pressures with said pressure difference reference values.

11. The apparatus according to claim 10, **characterized in** that said storing means is provided for storing the results of the comparison of said difference between said quotient $\Delta P/\Delta V$ in workload and rest situations with said quotient reference value.

12. A pacemaker, **characterized in** that it comprises an apparatus according to any one of the preceding claims and control means (14) for optimising pacing therapy depending on the result of said comparisons with said predetermined reference values.

13. The pacemaker according to claim 12, **characterized in** that it comprises a rate responsive sensor (22) for determining the workload situation of the patient.

14. The pacemaker according to claim 12 comprising a pressure sensor, **characterized in** that said pressure sensor (22) is arranged as said activity sensor.

15. The pacemaker according to any of the claims 12 – 14, **characterized in** that it comprises pressure compensating means including a pressure sensor located on the pacemaker capsule or on a satellite, intended to be implanted in body tissue close to the pacemaker.

16. A method of detecting diastolic heart failure, DHF, comprising the step of determining at least one blood pressure parameter for detecting a DHF state of the heart of a patient, **characterized in** that absolute value of left atrial pressure is measured (32) during the diastasis phase just before atrial contraction for a predetermined workload situation and a rest situation of the patient, and the difference, ΔP, between left atrial pressure measured in said workload and rest situations is compared (56) with a predetermined pressure difference reference value for DHF detection.

17. A method of detecting diastolic heart failure, DHF, comprising the step of

determining at least one blood pressure parameter for detecting a DHF state of the heart of a patient, **characterized in** that absolute value of the pressure in the pulmonary vein is measured when the pulmonary valve is closed for a predetermined workload situation and a rest situation of the patient, and the difference, ΔP, between said pulmonary vein pressure measured in said workload and rest situations is compared with a predetermined pressure difference reference value for DHF detection.

18. The method according to claims 16 or 17, **characterized in** that the impedance is measured between a left ventricular electrode (8) and a second electrode (10) intended to be positioned in such a place that most of variations in the measured impedance are due to varying left ventricular volume for said predetermined workload situation and for the patient in rest, whereupon the end-diastolic volume is determined from a predetermined relation between said measured impedance and the left ventricular volume, and in that a quotient between said difference between measured absolute pressure values, ΔP, and the corresponding difference between end-diastolic volumes, ΔV, for said workload and said rest situations, is formed (54) and compared (56) with a predetermined quotient reference value for DHF detection.

19. The method according to claim 18, **characterized in** that in a calibration procedure instantaneous values of the left ventricular volume are measured by ultrasound technique and said relation is established between these measured ventricular volume values and simultaneously measured impedance values.

20. The method according to any of the claims 17 – 20, **characterized in** that an average value of said absolute pressures is measured (38,40,42,44,46) during a plurality of cardiac cycles with said predetermined workload situation and an average value of said absolute pressures is measured during a plurality of cardiac cycles with the patient in rest.

21. The method according to claim 20, **characterized in** that an average value of said impedance is measured (38,40,42,44,46) during a plurality of cardiac cycles with said predetermined workload situation and an average value of said impedance is measured during a plurality of cardiac cycles with the patient in rest.

22. The method according to any of the claims 16 – 21, **characterized in** that the results of the comparison of said pressure differences with said pressure difference reference values are automatically sent to external receiver means.

23. The method according to claim 22, **characterized in** that the results of the comparison (56) of said difference between said quotient $\Delta P/\Delta V$ in workload and rest situations with said quotient reference value are automatically sent to external receiver means.

24. The method according to claim 16, **characterized in** that the measured absolute value of left atrial pressure is corrected with the mean pressure in right atrium or in vena cava close to the right atrium.

25. The method according to any of the claims 16 – 24, **characterized in** that said

pressures are measured for different workloads of the patient and for the patient in rest at an early time, when the patient is not suffering from DHF, for determining said pressure difference reference values.

26. The method according to claim 25, **characterized in** that said impedance is measured for different workloads of the patient and for the patient in rest at an early time, when the patient is not suffering from DHF, for determining said quotient reference value.